Welcome to CMPT 433
Embedded Systems
Topics

1) Introductions
2) What's an embedded system?
3) Course overview
4) BeagleBone & Zen Cape preview
Instructor: Dr. Brian Fraser
Guide to Slides

• Slide Colour Guide (often...):
  – Green: headings.
  – Yellow: Highlighted text.
    • This course has no midterm and one final.
  – Blue: Term being defined.
    • Hour: 60 minutes.
  – Sweep-in Text: Blanked out text.

• Joke:
  – There are 10 types of people in the world...
Classroom Expectation

• Only one thing:
  - Texting, playing games, checking facebook (back row)
  - Talking (vs participating!)

• If sending me or TA an email:
  - Post to Piazza instead?
  - Give a little context (class, your name, topic, ...) If you are sending more than 2 per week, may be too many.

• If sick, please message vs coming to office hours.
What is an embedded system?
What is an Embedded System?

- **Embedded System:**
  - A Computer system designed to do...
  - Usually does not have a keyboard, screen, mouse.

- **Spectrum of Examples:**
  - Controller in an AA-battery recharger.
  - Controller in a laser printer.
  - Air-quality controller on international space station.
  - Control software in an autonomous vehicle.
Statistics

- 2008:
  - 10 billion CPUs manufactured. (~6.7 billion people on Earth)
  - 6.1bn ARM CPUs in 2010

http://en.wikipedia.org/wiki/Microprocessor
http://images.content.ubmtechelectronics.com/Web/UBMtechElectronics/%7Ba7a91f0e-87c0-4a6d-b861-d4f1447707f831%7D_2013
EmbeddedMarketStudyb.pdf
Embedded System Development

• Cross-compiling:
  - Development done on the PC using powerful tools: editor, compiler, debugger, etc.
  - Compiled code...
Discussion

In groups of 3 to 4 people:
- Exchange email address;
- Answer the following:

1. What are 5 different embedded systems in the room right now? Which is most interesting?

2. What one computer failure could be most life critical? Is it an embedded system?

3. What is the best or worst thing an embedded system could be used for?
Course Overview

**WEEK ONE**

Hey, it's your cousin I got a new computer but don't want Windows. Can you help me install "Linux"?

Sure.

**WEEK TWO**

It says my Xorg is broken. What's an "Xorg"? Where can I look that up?

Hmm, lemme show you man pages.

**WEEK SIX**

Due to auto-config issues, I'm leaving Ubuntu for Debian.

Uh or Gentoo. Uh oh.

**WEEK TWELVE**

You haven't answered your phone in days. Can't sleep. Must compile kernel.

I'm too late.

Parents: Talk to your kids about Linux... before somebody else does.
Course Overview

• Goal
  − Qualified for junior embedded software developer.
  − Course mostly...
    • *May* spend hours solving build issues, and downloading code to device.

• Course Components

- Embedded Basics & Hardware
- Linux Coding & Admin
- Linux Kernel & Drivers
- Bare Metal
What to expect

• Fill out “Boot-Up” survey (see Piazza)!
• Previous students have found this course:
  – very rewarding to do so much hands-on, and
  – very time consuming to do so much hands-on!
• So be ready for:
  – A lot of C/C++/Linux programming
  – Steep initial learning curve working with real HW
  – Group work
  – Spending good time on this course each week.
• Stay on top of assignments and how-to guides.
• Submitted code may anonymously be discussed in class
Admin Review

- Review Course-Info page on website
  - Assessment %'s, no midterm exam.
  - Quizzes: A couple days after how-to guide released.
  - Assignments: Individual/pairs to learn skills. *Anon code reviews in class may feature your code!*
  - Project: group (3-4) to accomplish more.

- Academic Honesty
  - I am *passionate* about proving who did their own work.
  - Corollaries:
    - I'll give you credit for the work you do.
    - I'll catch those who don't do their own work.
Hardware Package
BeagleBone Green (BBG)

- 10/100 Ethernet
- DC Power and USB Client
- USB Host
- LEDs
- Reset Button
- Power Button
- eMMC
- Ethernet PHY
- Sitara AM3358
- Serial Debug
- 512M DDR3
- Boot Button
- USB
- I2C Grove Interface
- UART Grove Interface
Zen Cape

- 2x Tri-colour LED (GPIO and PWM)
- Buzzer
- Buzzer Disable Jumper
- Serial via USB (micro USB)
- 2 character Display (via I2C)
- Audio Out
- Audio In
- Potentiometer (analog)
- Joystick (GPIO)
- EEPROM
- Accelerometer
BeagleBone & Zen
Demo

- BeagleBone Black Demo
  - Boot & show in terminal
  - Linux commands: ls, cd, echo
  - Blink LEDs
  - Ethernet ping / web server
Logistics

• Buying a Board Package
  - Package includes:
    BeagleBone, Zen cape, mounting board, anti-static bag, USB cables, electronics, box.
  - Sold for less than $200 (price TBA)
  - Sell on Friday after class (cash or cheque)

• Academic Honesty
  - Each student must have own board: sharing encourages *too much* cooperation.
Summary

• Course is hands on:
  – Learning skills, not so much theory.
  – Expect to spend quite a bit of time figuring things out
• **Hardware on sale after next class!**
• Complete your Boot-up quiz before next class